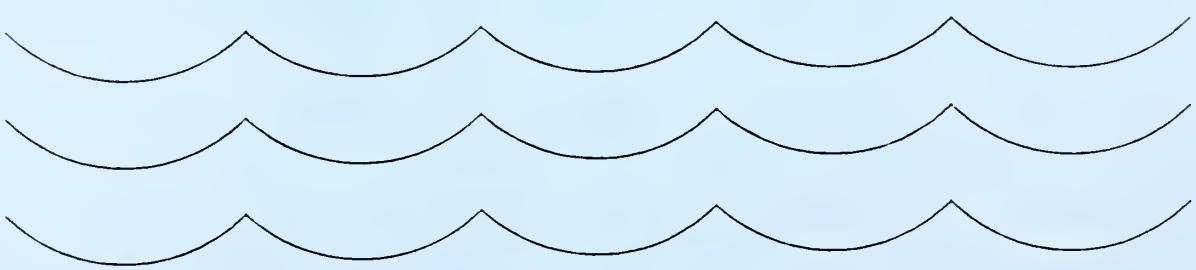
A FLOOD PLAIN MANAGEMENT STUDY

For the Town of Tunbridge, Vermont

PREPARED IN COOPERATION WITH

- Town of Tunbridge
- White River Natural Resources Conservation District
- Vermont Department of Environmental Conservation



FOREWORD

The U.S. Department of Agriculture, Soil Conservation Service, prepared the information in this flood plain management report. Officials of the Vermont Agency of Natural Resources and Department of Environmental Conservation, the White River Natural Resources Conservation District, and the Town of Tunbridge cooperated in compiling the report.

The flood hazard and land use information should serve as a technical base for flood plain management programs. State and local governments, as well as the public, will benefit from knowledge of flood information on the First Branch of the White River. A program to minimize future flood damages can be developed from this information. Describing the legal aspects and methods of conducting management programs is not within the scope of this report. However, some general recommendations are included.

We thank the many people who contributed information for the study. We also thank the landowners who gave permission for field surveys.

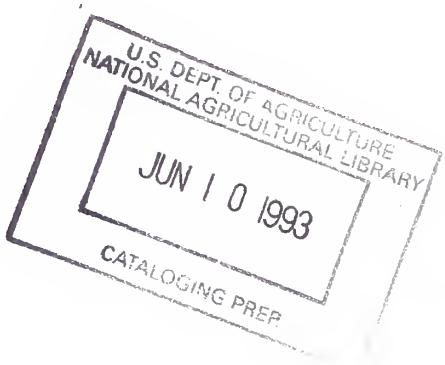


TABLE OF CONTENTS

	Page
Introduction	1
Study Area Description	2
Natural and Beneficial Values	3
Factors Affecting Flooding	5
Flood Problems	6
Existing Flood Plain Management	9
Alternatives for Flood Plain Management	10
Floodway Determination	11
Flood Hazard Maps	11
Glossary of Terms	13
References Cited	16
Appendix A	
Use of Appendix	A1
Flood Hazard Area Sheet Index	A2
Flood Hazard Area Photomaps (with profiles on reverse)	A3-A8
Investigations and Analysis	A9
Safety and Protection	A10
Tabulations of Water Surface Elevations	A13
Tabulations of Elevation Reference Marks	A16

FLOOD PLAIN MANAGEMENT STUDY
TOWN OF TUNBRIDGE
ORANGE COUNTY, VERMONT

Introduction

The Vermont Agency of Natural Resources (VT-ANR), the Town of Tunbridge, and the White River Natural Resources Conservation District (NRCD) coordinated in this flood plain management study and report preparation. The VT-ANR provided overall coordination for the study and assisted with the field surveys. The Town of Tunbridge has provided public participation, made necessary arrangements for field surveys, provided base maps, and duplicated and distributed this report. The NRCD has also cooperated in the effort.

The state and local entities requested the flood plain management study to provide detailed flood frequency characteristics and other analyses for a major portion of the flood plain system within the Town of Tunbridge. The town was experiencing increasing pressures for development of flood prone areas and lacked detailed flood plain information.

The U. S. Department of Agriculture, Soil Conservation Service (SCS) participated in the study and preparation of this report under the authorities of Section 6, Public Law 83-566, as amended; Executive Order 11988, Flood Plain Management, dated May 24, 1977; Recommendation 3, a Uniform National Program for Flood Plain Management, Water Resources Council, September 1979; and U. S. Department of Agriculture's Secretary's Memorandum Nos. 1606 and 1607, November 7, 1966.

The Vermont Department of Environmental Conservation, a department within the VT-ANR, is responsible for making studies, policies, and plans for the use, development, and protection of Vermont's water resources under Chapter 37, Title 10, of the Vermont Statutes Annotated.

This report provides a description of the flood plain system including its natural values, flood-frequency-stage-inundation relationships, and alternatives for flood plain management consideration.

Study Area Description

The First Branch of the White River Watershed is located in east central Vermont in the Connecticut River basin (Hydrologic unit number 01080105050). It has a drainage area of about 62,000 acres at the Tunbridge town line and includes parts of ten towns: Brookfield, Chelsea, Corinth, Randolph, Royalton, Strafford, Tunbridge, Vershire, Washington, and Williamstown . The main populated areas are Chelsea and Tunbridge, with a combined population of about 2,100 people.

The headwaters of First Branch begins in Washington to the east, the Piedmont Foothills of Brookfield (Lighthouse Hill) and Washington (Washington Heights and Boyce Hill) and flows in a southerly direction emptying into the White River. The river has numerous tributaries with the principal streams being Kennedy Brook, Cram Brook, Jail Brook, Jenkins Brook, Bicknell Brook, Larkin Brook, Foundry Brook, Potash Brook, Farnham Branch and Button Brook.

This report provides detailed information on 9.6 miles of the First Branch of the White River within the town of Tunbridge, Vermont. The Sheet Index Map provides locations of this studied stream reach. The drainage areas to the Royalton town line is 96.8 square miles.

The Town of Tunbridge is located at 43^{o} - 53′ north latitude, 72^{o} - 29′ longitude. It has a cool, humid climate. Average annual precipitation is 36 inches, which includes an average of 75 inches of snowfall. The mean annual temperature is 41^{o} F with a winter minimum of -29^{o} F and a summer maximum of 94^{o} F.

Natural and Beneficial Values

The Vermont State water quality classification is Class B for the First Branch of the White River and all of its major tributaries. This designation implies that the waters are suitable for bathing, recreation, fish habitat, irrigation, and public water supply with filtration and disinfection. Generally, Class B waters also have good aesthetic values. No significant aquifer protection areas have been delineated in the town of Tunbridge.

There is are good opportunities for canoeing and kayaking on the First Branch, throughout the length of the Town. This recreation occurs primarily during spring runoff and provides intermediate white water boating for about 17 miles of stream, 8 of which are in Tunbridge.

The First Branch also provides for some high quality fishing, mostly for brook, brown, and rainbow trout. The smaller tributaries also support native brook trout populations. The only open waterbody in the town is Trout Pond, located in the headwaters in the southeastern corner of the Town. There are no other natural or man-made impoundments in Tunbridge along the First Branch or any of its tributaries. First Branch is also recognized as a relatively undeveloped river corridor by the State.

For over ten years an inter-agency project has been working to restore Atlantic Salmon to the Connecticut River and its tributaries. At this time Salmon have been restored upriver to the Wilder Dam, approximately 1 mile above the mouth of the White River. Salmon have been stocked in the White River and its tributaries, including First Branch, for a number of years. Future plans call for continued stocking and improved access for the fish throughout the basin.

The First Branch Watershed is dominated by northern hardwoods, interspersed with open farmlands and small wetlands. This mixture of vegetation provides habitat for deer, moose, bear, songbirds, furbearing mammals, and waterfowl. Almost the entire 8 mi. stretch of First Branch in Tunbridge has been recognized as having high quality deer yards located adjacent to it. The total area of high quality deer yards probably exceeds 2,000 acres, most of which which is in close proximity to the river. There are no publicly owned expanses of land located in Tunbridge.

No State or Federal endangered species have been identified in the First Branch Watershed. However, transients such as the American Bald eagle and the Peregrine falcon may visit the watershed during spring and fall migrations.

There are no natural or geologic features in the Town which have received regional or state recognition.

No prehistoric sites are currently known to exist in the watershed. Based upon topographic features and knowledge of prehistoric man's habitat, the First Branch Watershed is not expected to contain significant archaeological sites.

Six historic resources in Tunbridge are listed on the national or state registers. Tunbridge's five covered bridges, Mill, Larkin, Howe, Cilley, and Flint are all on the Federal Register of Historic Places. The Historic District in South Tunbridge Village is on the State Register of Historic Places.

Tunbridge is renowned for its "World Fair" held annually at the fairgrounds in Tunbridge Village. These fair grounds are located within the flood plain of the First Branch.

Factors Affecting Flooding

Obstructions to floodflows can have a tremendous impact on flood elevations. Obstructions can be either natural or man-made. Natural obstructions that impede floodflows may be sharp bends in stream alignment, channel constrictions due to topography of adjacent terrain, shoaling, rock outcrops in the stream or on the flood plain, ice jams, and vegetation such as grass, brush or trees. As floodflow is impeded, the velocity of the water decreases and the depth of flow increases; this results in flooding along streams. Man-made obstructions include bridges, culverts, dams, docks, levees, and earthfills. These man-made obstructions may severely hamper flow and cause a backwater condition, which creates more flooding than what would normally occur with only natural obstructions present.

During floods trees, brush, ice and other debris may be washed downstream to collect on bridges and other obstructions to flow. This is often referred to as a "log jam" or "ice jam". As the floodflow increases, masses of debris can suddenly break loose and a wall of water and debris surges downstream until another obstruction is encountered. Debris may collect against a bridge until the load exceeds its structural strength and causes the bridge to fail.

The limited capacity of obstructed bridges, debris plugs at bridge waterway openings, or a combination of these factors cause flooding upstream and erosion around bridge approach embankments. This erosion can cause damage to the overlying roadbed. In general, obstructions restrict floodflows and result in overbank flows. Unpredictable areas of flooding, destruction of, or damage to bridges, and an increased velocity of flow immediately downstream can also occur from obstructed bridges.

It is impossible to predict the degree or location of debris accumulation. Therefore, in the development of flood profiles for this report, it was necessary to neglect the possibility of log-jams, ice jams and the possibility of debris blocking bridges or culverts.

Flood Problems

The Town of Tunbridge has experienced severe flooding this century during November 1927, March 1936, September 1938, June 1973, and August 1976. The Town experienced major streambank and property damage during these floods.

In general the residences that would be exposed to flooding at the 100 year frequency would experience relatively minor damage. Flooding would generally be confined to the basement. Precise dollar damages would be difficult to quantify with out close examination of the properties threatened. Table 1 provides a further description of the flood hazard.

Although the existing flood damage potential is not great, the Town of Tunbridge is experiencing development pressures. The flood plain needs to be properly managed to avoid high flood damage potential in the future.

Depths of flow in the First Branch of the White River range from 10.2 feet at section FB01 to 20.4 feet at section FB68 with velocities of about 2.0 fps at section FB50 to 16.0 fps at section FB01.

Figures 1 through 4 show the water surface level of the 100 and 500-year flood at selected localities.

Table 1 Characteristics of Potential Flood Damages
Town of Tunbridge, Vermont

Stream	Type of Land Use	Acres by Flood Frequency 100-Year	500-Year
			(Additional Acres)
First Branch White River	Open	345	30
	Woodland	8	5
	Residential and structural	20	4
	Totals	373	39

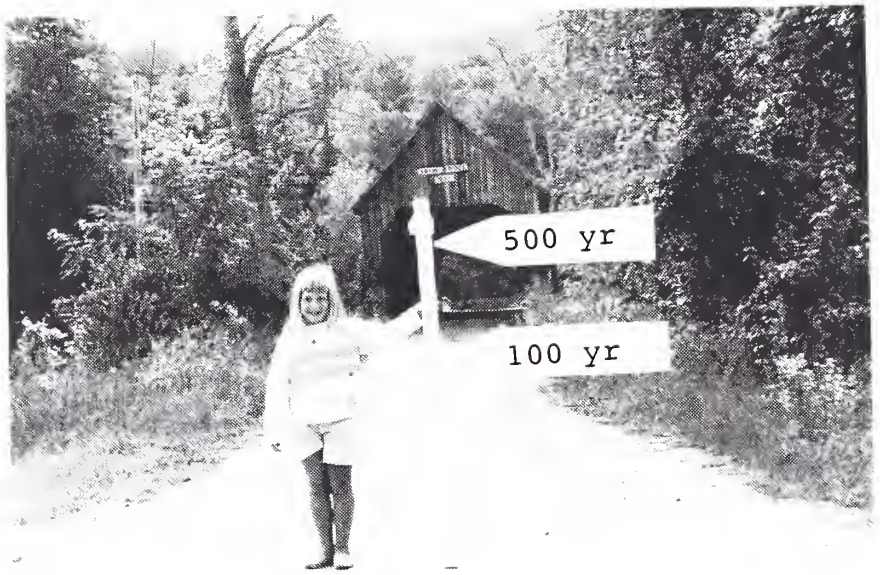


Figure 1. West side of Larkin Bridge

Figure 2. West side of Foundry Road bridge.

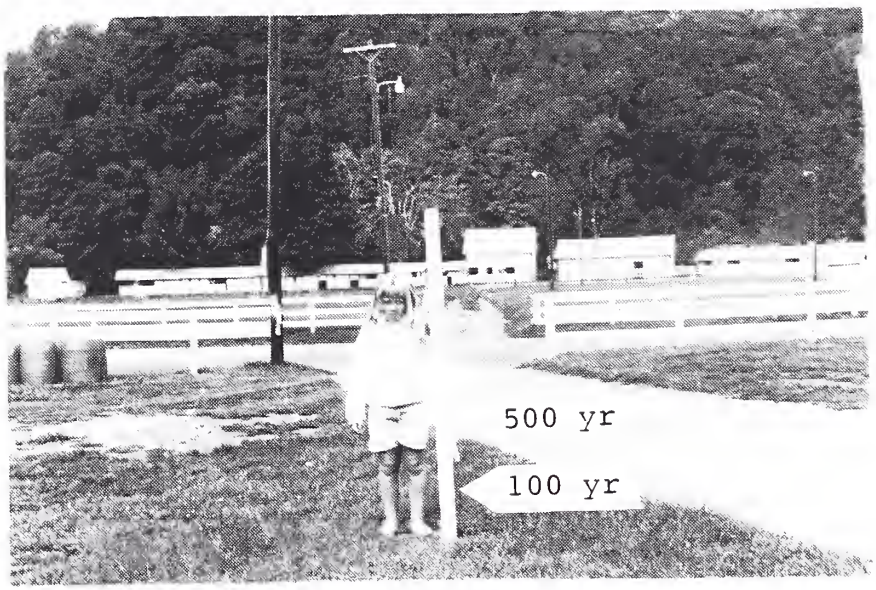


Figure 3. Tunbridge Fairgrounds

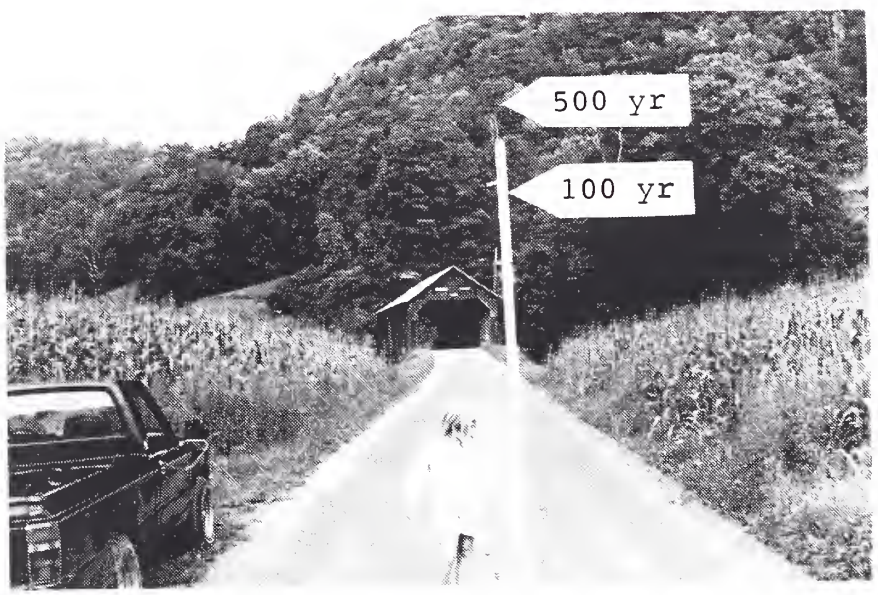


Figure 4. East of Cilly Bridge

Existing Flood Plain Management

In Vermont, municipalities have the authority to regulate development in flood hazard areas under Title 24 VSA chapter 91. Title 10 VSA chapter 32 authorizes the Secretary of the Agency of Natural Resources to designate flood hazard areas and to assist the towns with flood hazard regulations. Title 25 VSA subsection 4409 requires towns to submit a report to Environmental Conservation before issuing a permit for development in a designated flood hazard area.

Several other Laws and regulations administered by the state contain special requirements for development in flood hazard areas. Some of these are:

Act 250 (10 VSA chapter 151) administered by the Environmental Board and District Environmental Commissions;

Health Regulations administered by the Protection Division of the Agency of Natural Resources;

Storage of Flammable Liquids (20 VSA section 2721) administered by the State Fire Marshal;

Stream Alteration (10 VSA chapter 28) administered by the Department of Environmental Conservation;

Dam Construction (10 VSA chapter 29) administered by the Department of Environmental Conservation.

Alternatives for Flood Plain Management

Present Condition

Allowing the current flooding situation to continue is a possibility although undesirable alternative. Essentially the flood damages enumerated in Table 1 would continue. Lack of control over development in the flood plain could result in further encroachment by development with the accompanying increases in flood damages.

Land Treatment

Inclusion of conservation practices for erosion and runoff control in new developments and building areas would help to assure protection against induced flooding from this source. Control of erosion and sedimentation, to protect stream capacities is an important consideration.

Nonstructural Measures

Floodproofing of buildings and other high value property in the flood plain is a particularly appropriate measure for reducing losses to individual properties. A flood warning system or plan would be of limited value as a nonstructural measure because the time to respond with emergency protection activities is only a matter of a few hours. Relocation of some residences and buildings or acquisition to eliminate risks may be appropriate in some instances. The Town of Tunbridge plans to adopt formal flood plain regulations which will be very helpful in assuring development in the future will not sustain frequent, severe flood losses. The national flood insurance program has made affordable flood insurance available to flood-prone property owners through private underwriters. Owners of existing flood prone property should consider flood insurance as a means of reducing their flood loss risk. Other nonstructural approaches such as emergency preparedness and building or development codes should be considered.

Structural Measures

There appears to be little opportunity for modifying floods through headwater impoundments (dams) or channel enlargement.

Combinations of Alternatives

Several of the above alternatives could be combined in a number of ways to provide a plan to address the flooding problems.

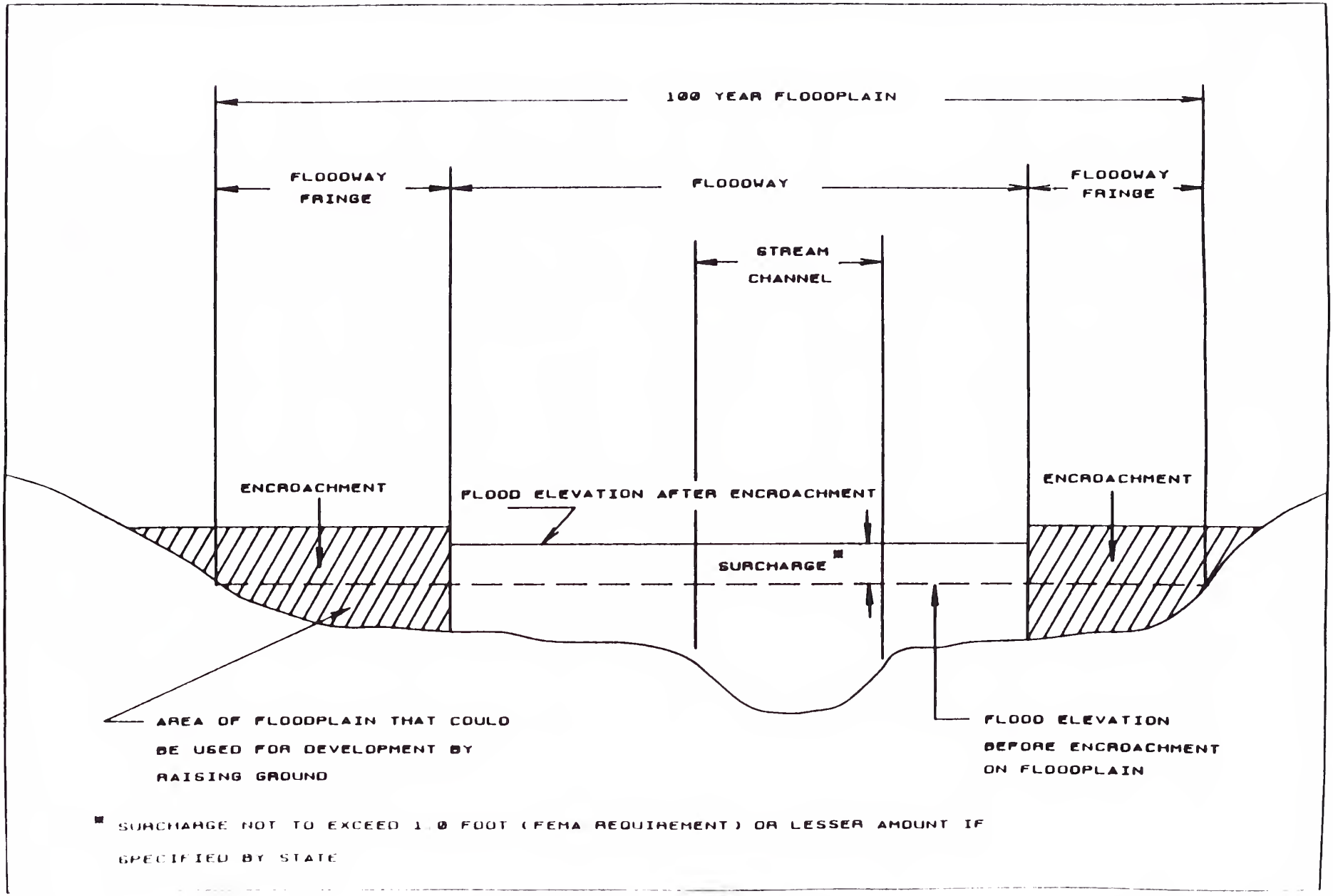
Floodway Determination

Any development activity that raises the elevation of the flood plain will restrict flow and increase flood heights. Communities have found benefits from allowing carefully controlled development to occur in the flood plain fringe provided resulting increases in flood hazard can be tolerated. The National Flood Insurance Administration uses the concept of floodway as an aid in evaluating such situations. This concept partitions the 100-year flood area into a floodway and a floodway fringe. The floodway fringe is the portion of the flood plain that can be completely obstructed without increasing the water-surface elevation of the 100-year flood more than one foot at any point. The floodway is the remaining portion of the channel and the flood plain (See Figure 5).

Flood Hazard Maps

The photomaps entitled "Flood Hazard Areas" (sheets 1 through 6 in Appendix A) show the 100-year and 500-year flood areas. These areas are depicted based on present land use and management conditions. The flood boundaries show the approximate location on the ground for general reference purposes. The 500-year flood boundary is to be interpreted as being close to the 100-year flood boundary where it is not separately mapped. The reason for this is that the valley side slopes along many reaches of stream are steep and the map scale small. This yields a 500-year boundary which is nearly contiguous with the 100-year boundary. Along such reaches it is therefore not mapped.

Flood boundaries were taken from the profiles and may not be mapped as accurately as the profiles themselves. For this reason it is recommended that you locate the property of interest on the profiles and establish the flood boundary (for desired frequency) on the property by field survey. Appendix A provides a tabulation of elevation reference marks that can be used in connection with this activity.



■ SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC

Figure 5

Glossary of Terms

backwater. High water caused by downstream obstruction or restriction, or by high stage on an intersecting stream.

BM. Benchmark of established elevation used for vertical reference.

bottom of culvert. Elevation of the lowest flow surface of a culvert (or pipe) through which flood flows pass.

cfs. Cubic feet per second - a unit of discharge that is equal to the flow of one cubic foot per second past a given point.

cross section. Shape and dimensions of a channel and valley perpendicular to the line of flow.

elev.-bridge deck. Elevation of a roadway across a bridge or culvert.

elev.-low chord. Elevation of lowest structural "beam" that limits the height of the bridge opening; or may indicate the top of a culvert opening.

elev.-low road. Elevation of low point on a roadway approaching or crossing a bridge or culvert - shown only if lower than elev.-bridge deck at a particular road section.

fps. Feet per second - units of velocity of stream flow.

flood. An overflow of lands not normally covered by water; a temporary increase in streamflow or stage; or the discharge causing the overflow or temporary increase.

flood frequency. An expression of how often a flood of given magnitude can be expected. Examples:

10-year frequency flood. The flood which can be expected or exceeded on an average once in 10 years; or which would have a 10 percent chance of being equaled or exceeded in any given year.

100-year frequency flood. ....one percent chance....in any given year.

flood peak or peak discharge. Highest discharge attained during a flood.

flood plain or flood-hazard area. Lands adjoining a stream (or other body of water) which has been or may be covered with water.

flood profile or profile. A plotted or imaginary line defining the highest water surface elevations along a stream during a particular flood.

flood-hazard area. See flood plain.

flood routing. Computation of the changes in the rise and fall in streamflow as a flood moves downstream. The results provide hydrographs of discharge versus time at given points on the stream.

floodway. The portion of the stream channel and flood plain that must be kept free of encroachment to prevent flood stages from rising more than 1 foot higher than natural conditions.

frequency-discharge curve. A plotted line showing the recurrence interval (or flood frequency) of discharges at a stream gage, surveyed cross section, or other station along stream. (Used with a stage-discharge curve to determine the high water elevations resulting from selected flood discharges at that station on the stream.)

hydrograph. A curve showing the rise and fall of flood discharge with respect to time at a specific station on the stream.

land use. Classification of type of vegetation or other surface cover conditions on a watershed - used (with a similar classification of soils) to indicate the rate and volume of flood runoff.

NGVD. National Geodetic Vertical Datum, the normal standard of elevation reference.

peak discharge or flood peak. The highest rate of runoff (discharge) attained during a flood.

profile. See flood profile.

runoff. That portion of the total storm rainfall flowing across the ground or other surface and contributing to the flood discharge.

stage-discharge curve. A plotted curve showing elevations resulting from a range of discharges at a surveyed cross section, stream gage, or other point on a stream.

top of culvert. Elevation of the uppermost flow surface of a culvert (or pipe) through which flood flows pass.

TBM. Temporary benchmark used for vertical reference.

watershed. A drainage area which collects and transmits runoff to the outlet of the drainage basin.

REFERENCES CITED

1. Topographic maps; 7 1/2 minute series; scale,1:24,000; U.S. Geological Survey, Washington, D.C. Chelsea, VT 1981, Vershire, VT 1981; Sharon, VT 1981; Washington, VT 1981; South Royalton, Vt. 1981; Brookfield, Vt, 1980; Randolph Center, Vt., 1980.

2. Water Resources Data for New Hampshire and Vermont, Water Year 1977, Report No. NH-VT-77-1, U.S. Geological Survey, Boston, MA; August 1978.

3. A Unified National Program for Flood Plain Management, U.S. Water Resources Council, Washington, D.C., September 1979.

4. Regulation of Flood Hazard Areas to Reduce Flood Losses, (two volumes), U.S. Water Resources Council, Washington, D.C., 1971 and 1972.

5. Flood Plain Management Handbook, U.S. Water Resources Council Washington, D. C.; September 1981.

6. Guide for Flood and Flash Flood Preparedness Planning, U.S. Department of Commerce, National Weather Service, Silver Spring, MD, February 1977.

7. Flood Flow Frequency, Bulletin 17B, U.S. Water Resources Council, Washington, D.C., September 1981.

8. Computer Program for Project Formulation, Hydrology, Soil Conservation Service Technical Release No. 20, May 1983.

9. WSP2 Computer Program, Soil Conservation Service Technical Release No. 61, May 1976.

10. Floodway Determination Computer Program, Soil Conservation Service Technical Release No. 64, June 1978.

11. National Engineering Handbook, Section 4, Hydrology; U.S. Department of Agriculture, Soil Conservation Service; Washington, D.C.; November 1954, Revised August 1980.

12. Vermont Agency of Environmental Conservation. 1986, Vermont River Study, Waterbury, VT.

13. Vermont Fish and Game Department. 1962 Vermont Stream Survey. Montpelier, VT.

14. Flood Insurance Study, Town of Royalton, Vermont, Federal Emergency Management Agency, Revised June 5, 1989.

USE OF APPENDIX

This appendix provides the data needed to use this report. Included in this appendix are:

Flood Plain area Photomaps

The Flood Plain Area Photomaps can be used for decisions where precise elevations are not required; for example, a brief check of the appropriate photomap may indicate that a proposed building site is obviously in or out of the flood plain.

Flood Profiles

On the reverse of each photomap are flood profiles, water surface elevation tabulations. These can be used with the photomaps to determine flood elevations at any point along the streams in the study area as follows:

1. On the appropriate photomap find the point on the stream where the proposed building is to be located; then scale the distance along the stream to the nearest cross section.

2. On the appropriate flood profile sheet, scale the distance determined in Step 1 from the cross section back to the original stream location, and read the elevation of the desired flood frequency line.

3. Transfer the elevation determined in Step 2 to the ground from the nearest established benchmark.

   If the point on the ground is at one of the surveyed cross sections, the elevation can be read directly from the tabulation of water surface elevations.

Investigation and Analysis

Investigations conducted and analysis used are described.

Safety and Protection

Steps that can be taken by individuals during a flood are discussed.

Tabulated Data

Tabulated elevations and discharges for each cross section of the 10, 50, 100, and 500 year storms.

Benchmark Data

Description and elevation of reference marks used in the study.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

VICINITY MAP

LEGEND

1 SHEET COVERAGE

STREAM REACHES

SHEET INDEX MAP

TUNBRIDGE FLOOD PLAIN MANAGEMENT STUDY

FIRST BRANCH WHITE RIVER
ORANGE COUNTY, VERMONT

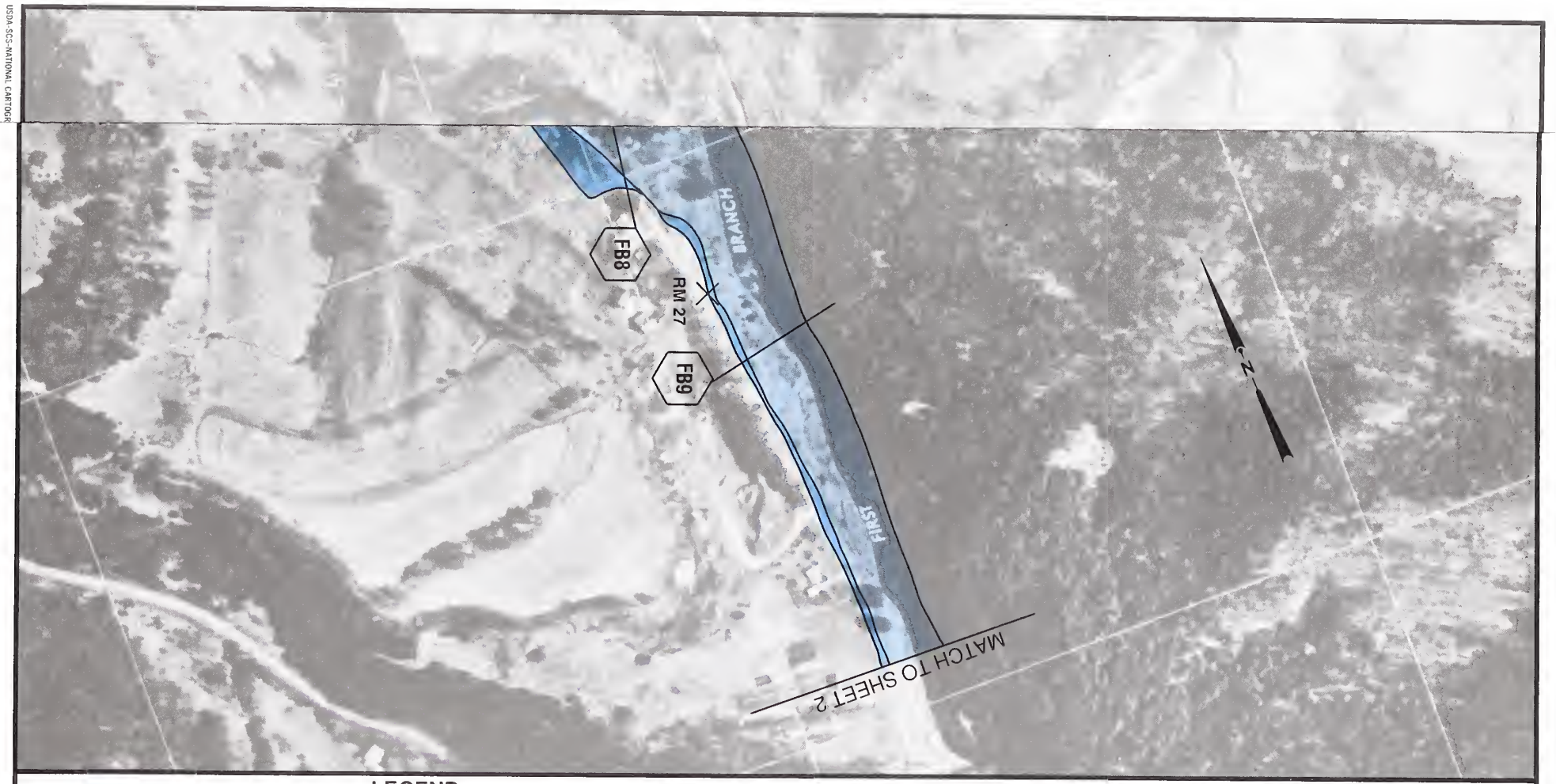
0 1 2
MILES

0 1 2
KILOMETERS

SOURCE:
ORANGE COUNTY GENERAL HIGHWAY MAP
PREPARED BY THE DEPARTMENT OF HIGHWAYS,
HIGHWAYS PLANNING DIVISION, VERMONT
AND INFORMATION FROM SCS FIELD PERSONNEL.
POLYCONIC MAP PROJECTION BASED ON U.S.
GEOLOGIC SURVEY MAPS.

JANUARY 1991 1005692-01

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT WORTH, TX -1992



LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- FB1 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- RM 27 — BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data

0 500 1000 FEET

0 100 200 300 METERS

1979 Photography by Vernon Graphics, Inc.

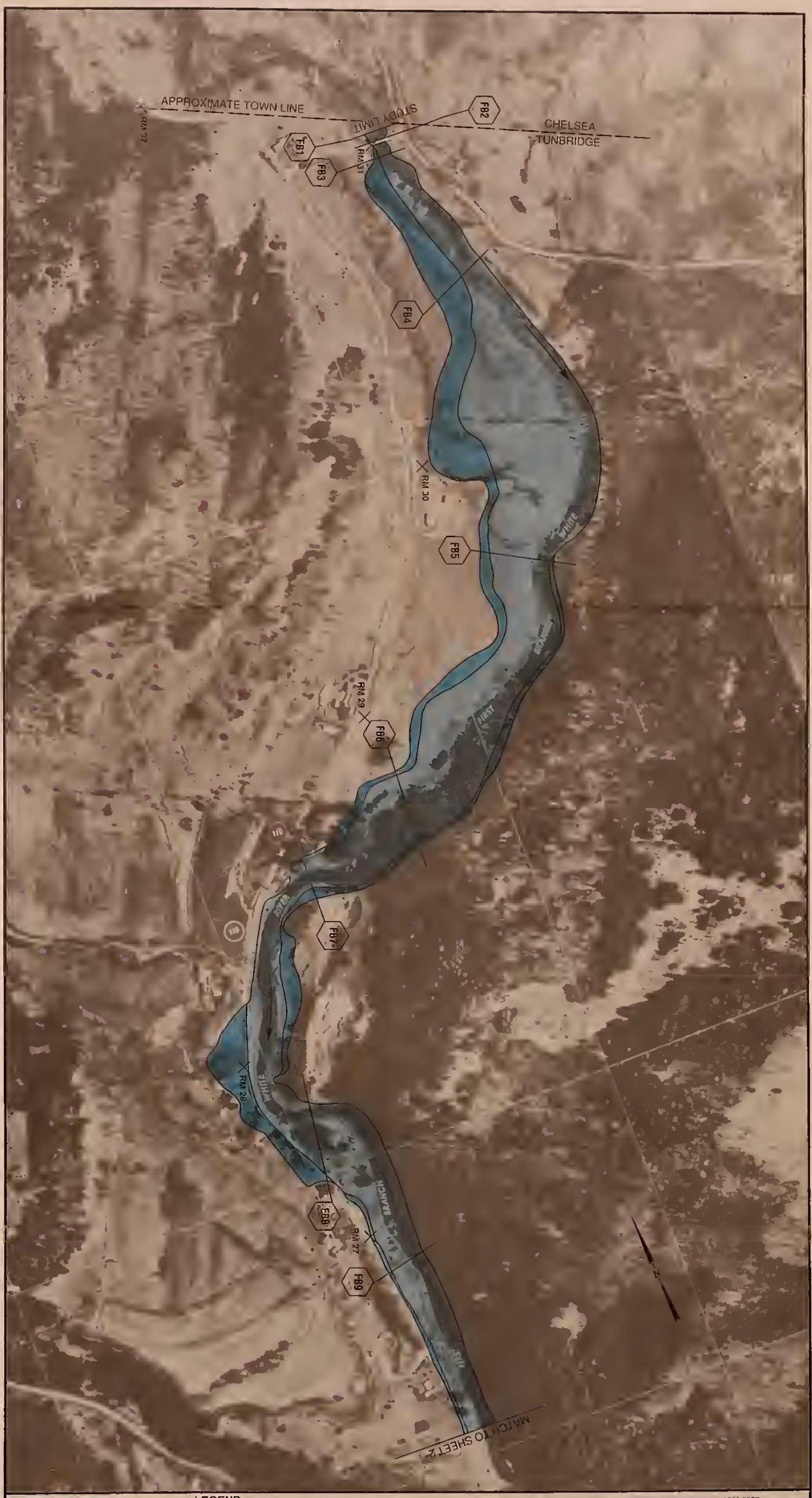
SHEET 1 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

FIRST BRANCH WHITE RIVER

JANUARY 1005692-02



LEGEND

100 YEAR FLOOD AREA

500 YEAR FLOOD AREA

FB1 SURVEYED CROSS SECTION

STREAM CHANNEL

RM 27 BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

0 500 1000 FEET

0 100 200 300 METERS

1979 Photography by Vernon Graphics, Inc

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

SHEET 1 OF 6

FLOOD HAZARD AREA

FIRST BRANCH WHITE RIVER

JANUARY 1005602.32

0 YEAR STORM

0 YEAR STORM

YEAR STORM

YEAR STORM

REAM BED

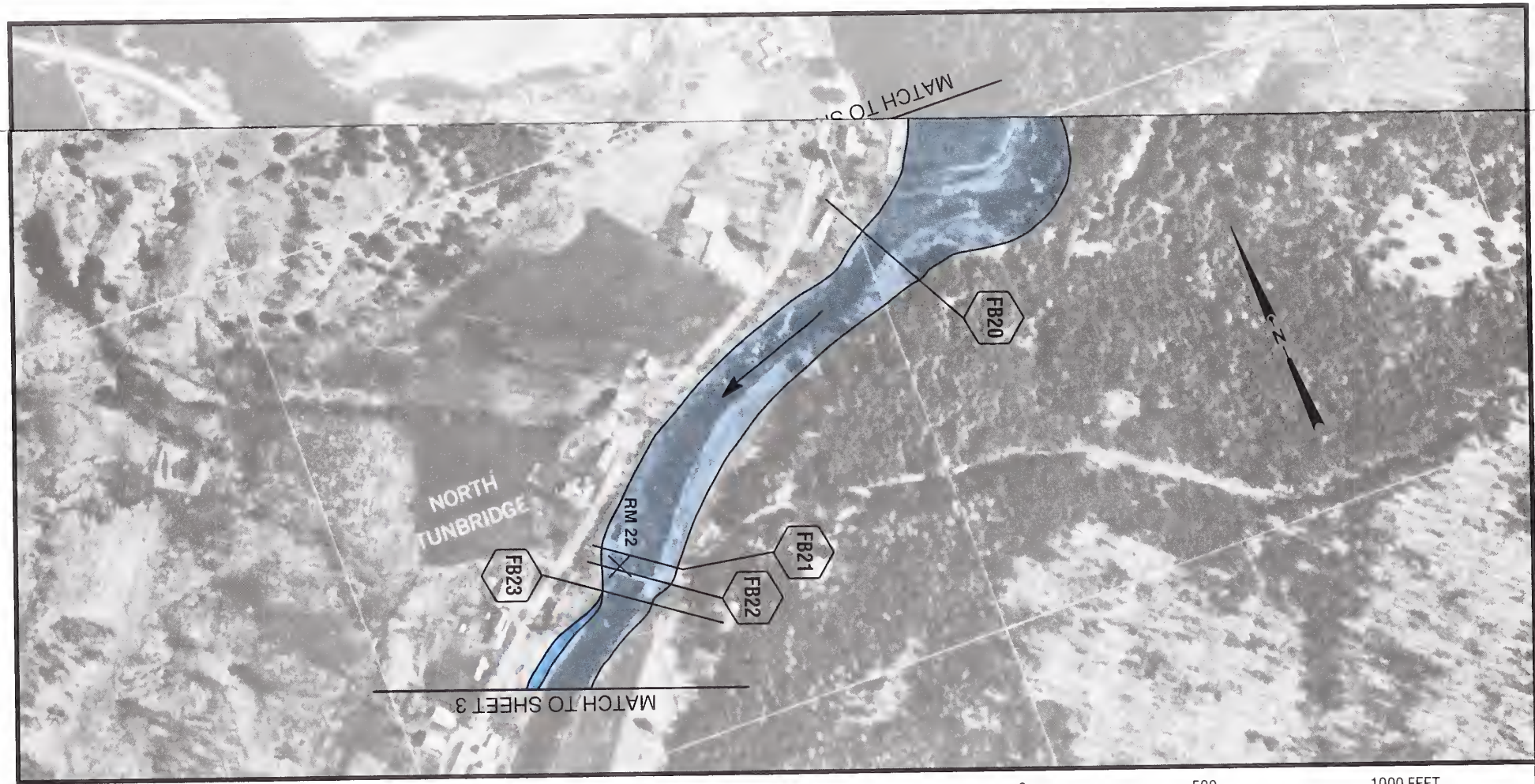
OSS SECTION
CATION

VER CROSSING

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
--TUNBRIDGE--
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD PROFILES

FIRST BRANCH WHITE RIVER



LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- FB10 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- RM 22 BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

0 500 1000 FEET

0 100 200 300 METERS

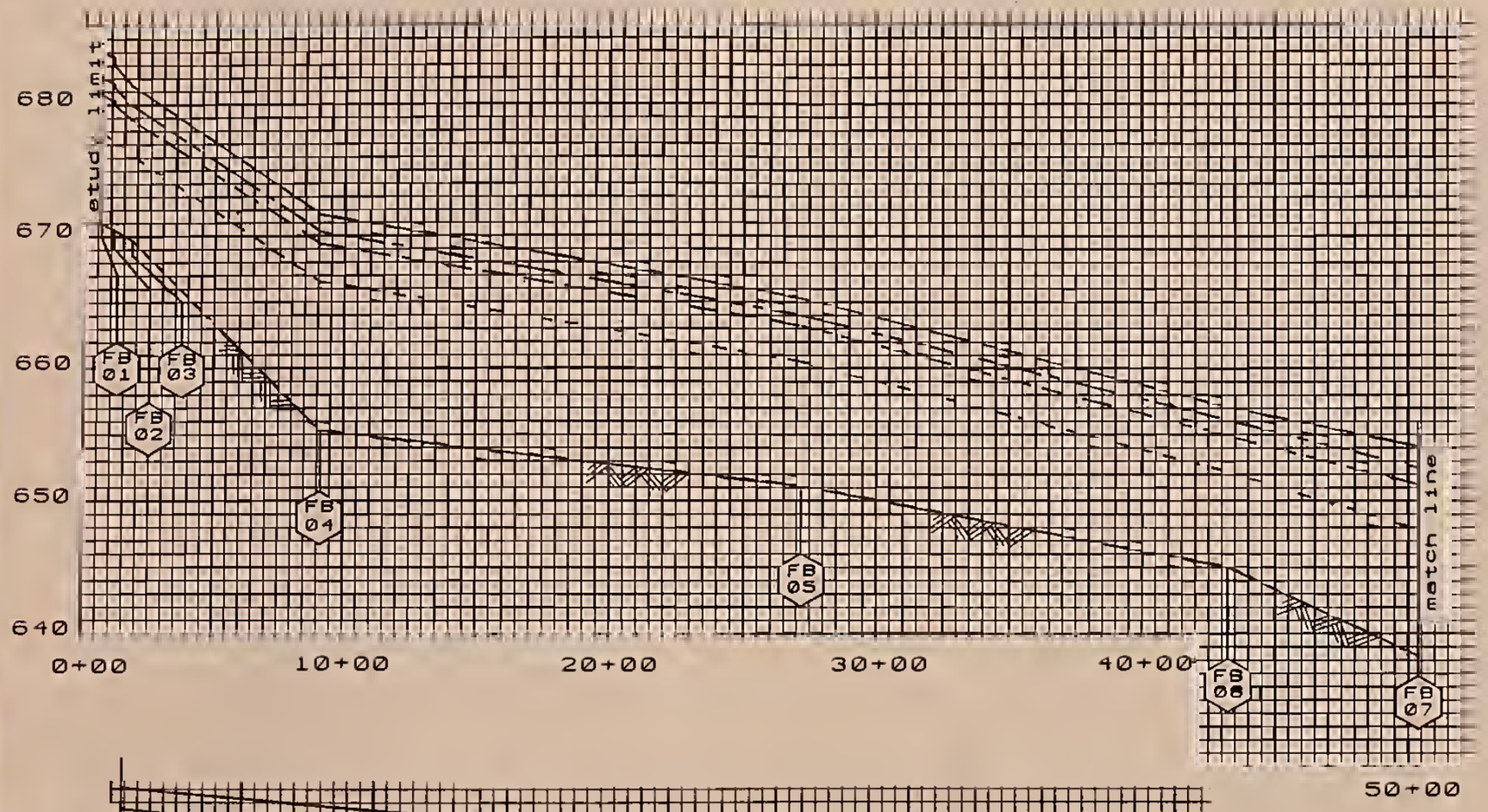
1979 Photography by Vernon Graphics, Inc.

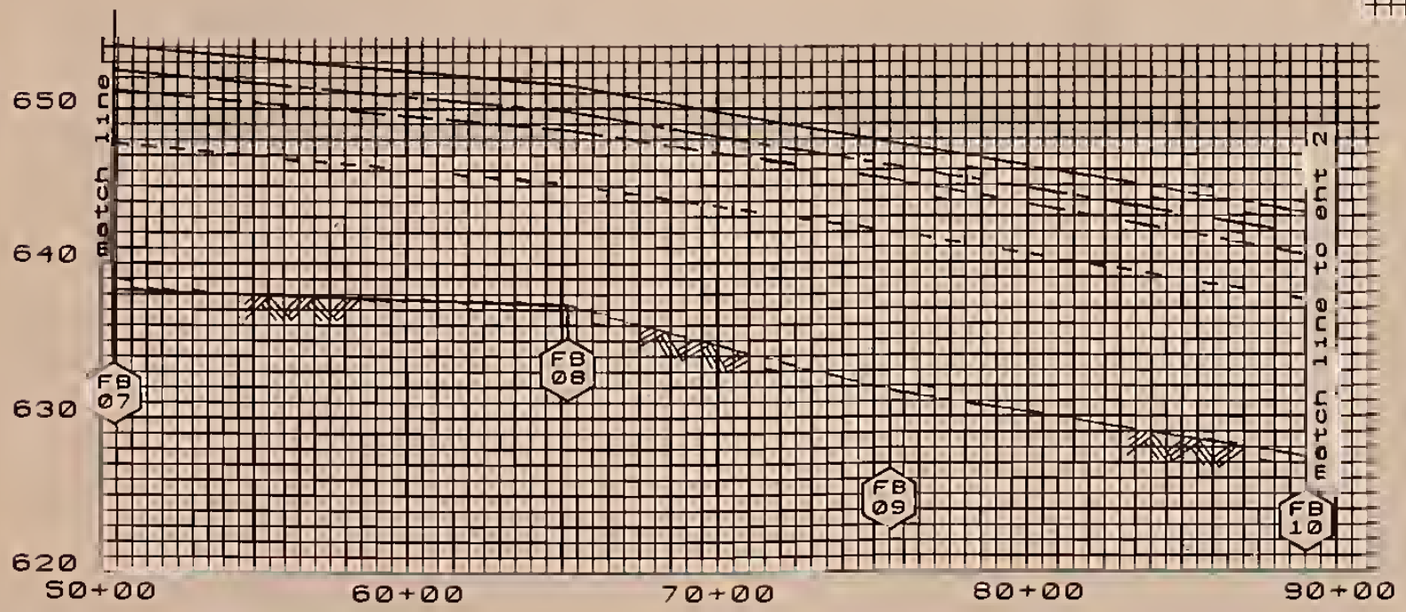
SHEET 2 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

FIRST BRANCH WHITE RIVER





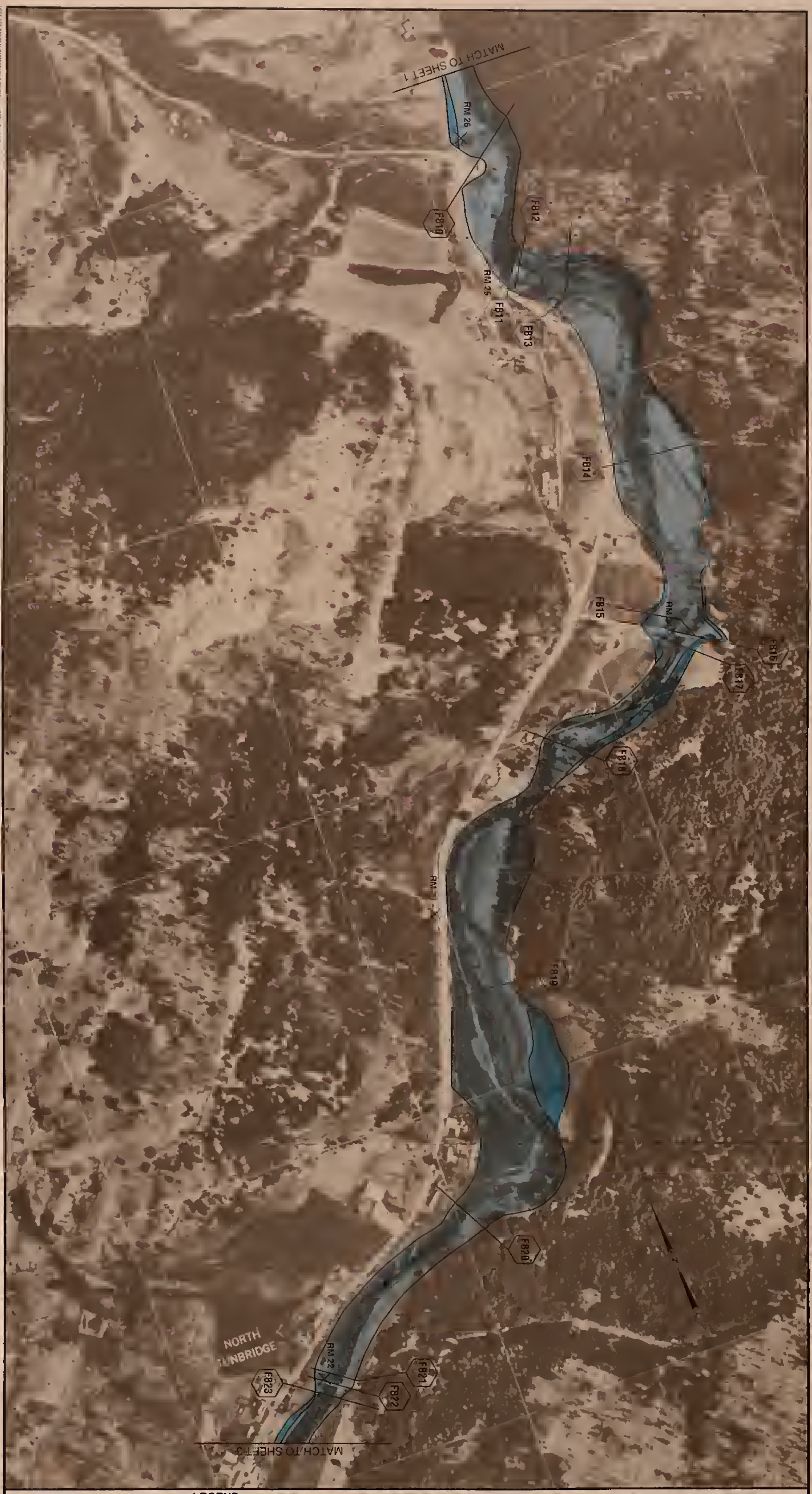
LEGEND

- 500 YEAR STORM
- 100 YEAR STORM
- 50 YEAR STORM
- 10 YEAR STORM
- STREAM BED
- 3 — CROSS SECTION LOCATION
- bridge deck / low chord — RIVER CROSSING

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
--TUNBRIDGE--
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD PROFILES

FIRST BRANCH WHITE RIVER



LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- FB10 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- RM 22 BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

0 500 1000 FEET

0 100 200 300 METERS

1979 Photography by Vernon Graphics, Inc.

SHEET 2 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

FIRST BRANCH WHITE RIVER

JANUARY 1005812-02

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX 1977

0 YEAR STORM

0 YEAR STORM

YEAR STORM

YEAR STORM

REAM BED

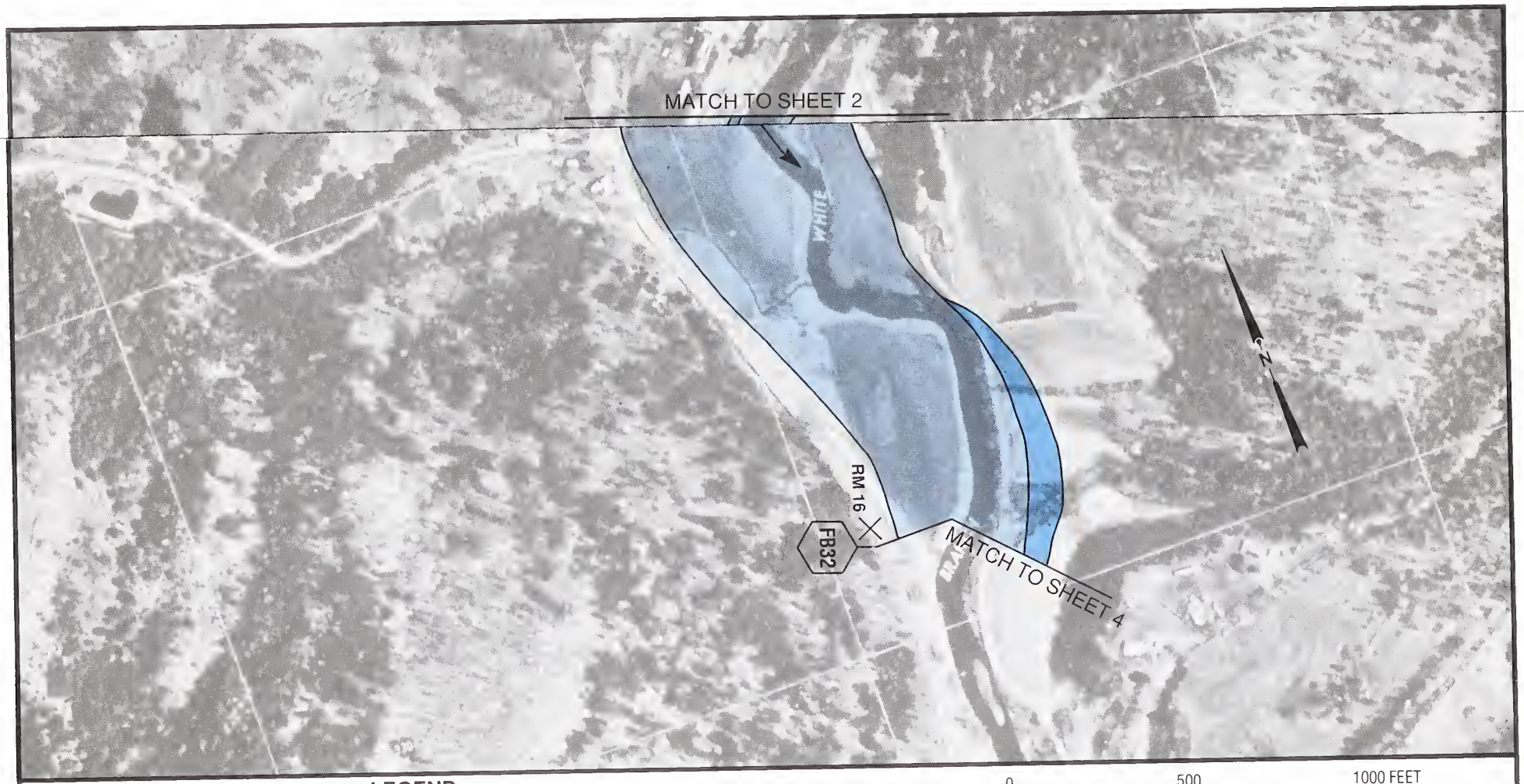
OSS SECTION
CATION

VER CROSSING

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
--TUNBRIDGE--
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD PROFILES

FIRST BRANCH WHITE RIVER



LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- FB24 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- RM 16 BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data

0 500 1000 FEET

0 100 200 300 METERS

1979 Photography by Vernon Graphics, Inc.

SHEET 3 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

FIRST BRANCH WHITE RIVER

JANUARY 1005692-02

LEGEND

- 500 YEAR STORM
- 100 YEAR STORM
- 50 YEAR STORM
- 10 YEAR STORM
- STREAM BED
- 3 — CROSS SECTION LOCATION
- bridge deck / low chord — RIVER CROSSING

FLOOD PROFILES

FIRST BRANCH WHITE RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
--TUNBRIDGE--
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

MATCH TO SHEET 2

RM 21
FB24
FB25
FB26
RM 20
FB27
RM 19
FB28
FB29
RM 18
FB30
FB31
RM 17
RM 16
FB32
MATCH TO SHEET 4

LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- FB24 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- RM 16 — BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data

0 500 1000 FEET
0 100 200 300 METERS

1979 Photography by Vernon Graphics, Inc.

SHEET 3 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

FIRST BRANCH WHITE RIVER

JANUARY 1005692.02

00 YEAR STORM

00 YEAR STORM

0 YEAR STORM

0 YEAR STORM

TREAM BED

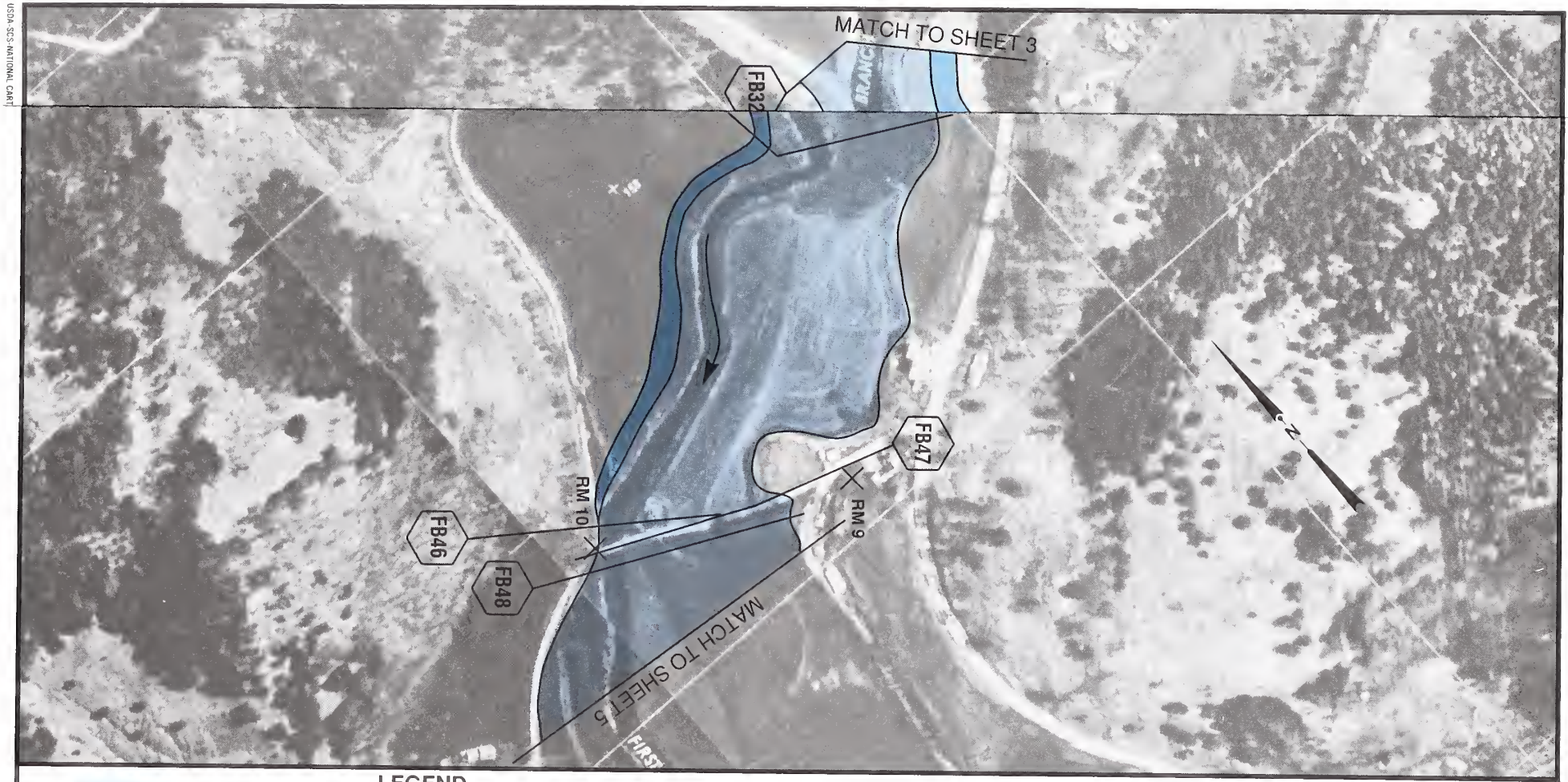
ROSS SECTION
OCATION

IVER CROSSING

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
--TUNBRIDGE--
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD PROFILES

FIRST BRANCH WHITE RIVER



LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- FB32 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- RM 9 — BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

0 500 1000 FEET

0 100 200 300 METERS

1979 Photography by Vernon Graphics, Inc.

SHEET 4 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

FIRST BRANCH WHITE RIVER

LEGEND

- 500 YEAR STORM
- 100 YEAR STORM
- 50 YEAR STORM
- 10 YEAR STORM
- STREAM BED
- CROSS SECTION LOCATION (3)
- RIVER CROSSING (bridge deck / low chord)

FLOOD PROFILES

FIRST BRANCH WHITE RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

--TUNBRIDGE--
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- FB32 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- RM 9 — BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

0 500 1000 FEET

0 100 200 300 METERS

1979 Photography by Vernon Graphics, Inc.

SHEET 4 OF 6

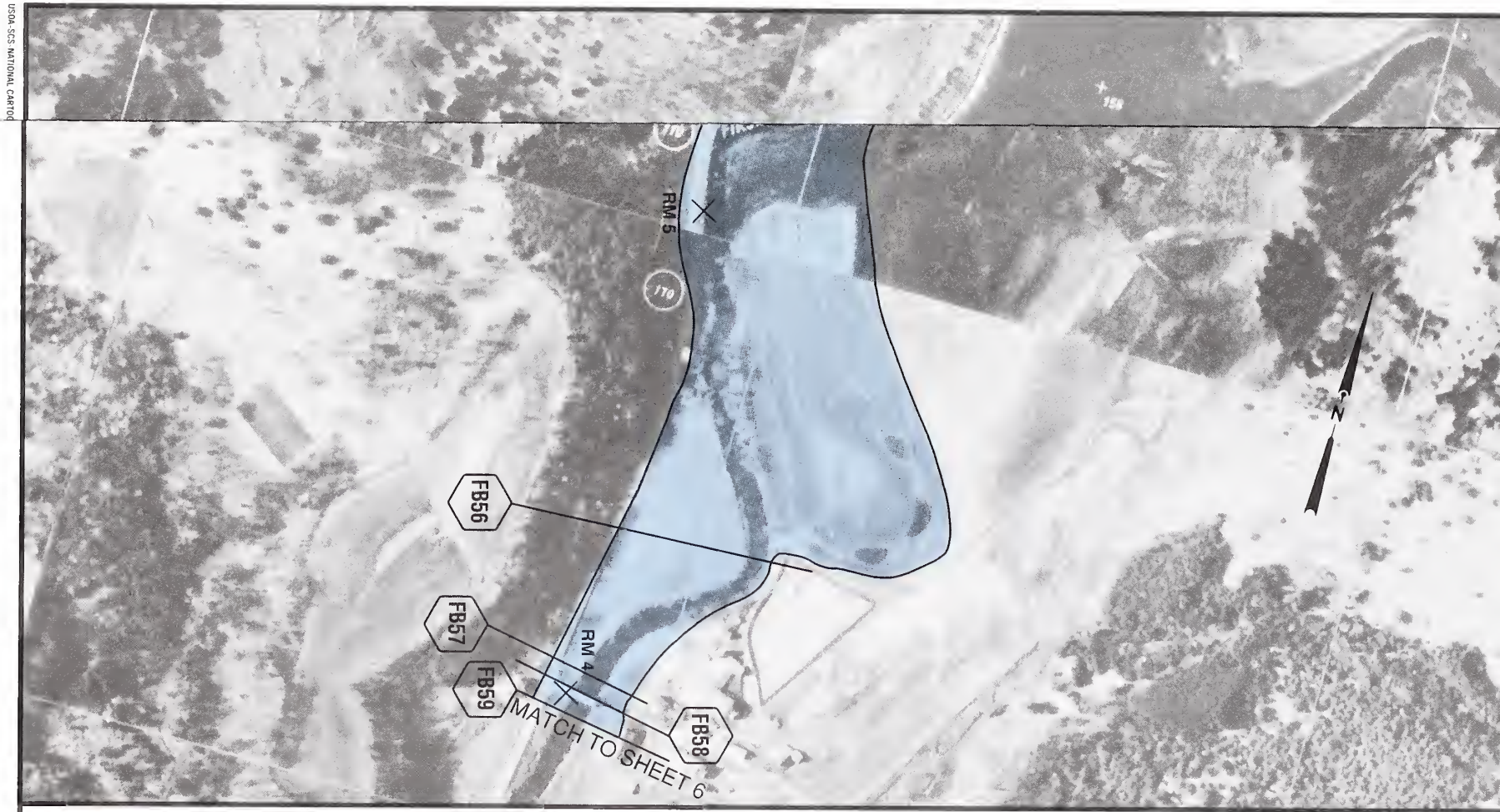
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

FIRST BRANCH WHITE RIVER

JANUARY 1005592-0

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE --TUNBRIDGE-- FLOOD PLAIN MANAGEMENT STUDY ORANGE COUNTY, VERMONT	FLOOD PROFILES FIRST BRANCH WHITE RIVER



LEGEND

100 YEAR FLOOD AREA

500 YEAR FLOOD AREA

FB49 — SURVEYED CROSS SECTION

STREAM CHANNEL

RM 4 — BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

0 500 1000 FE

0 100 200 300 ME

1979 Photography by Vernon Graphics, Inc.

USDA SCS NATIONAL CARTOG

JANUARY 100

SHEET 5 OF

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY

FLOOD HAZARD AREA

FLOOD PROFILES

FIRST BRANCH WHITE RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
--TUNBRIDGE--
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- FB49 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- RM 4 — BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

0 500 1000 FEET
0 100 200 300 METERS

1979 Photography by Vernon Graphics, Inc.

SHEET 5 OF 6

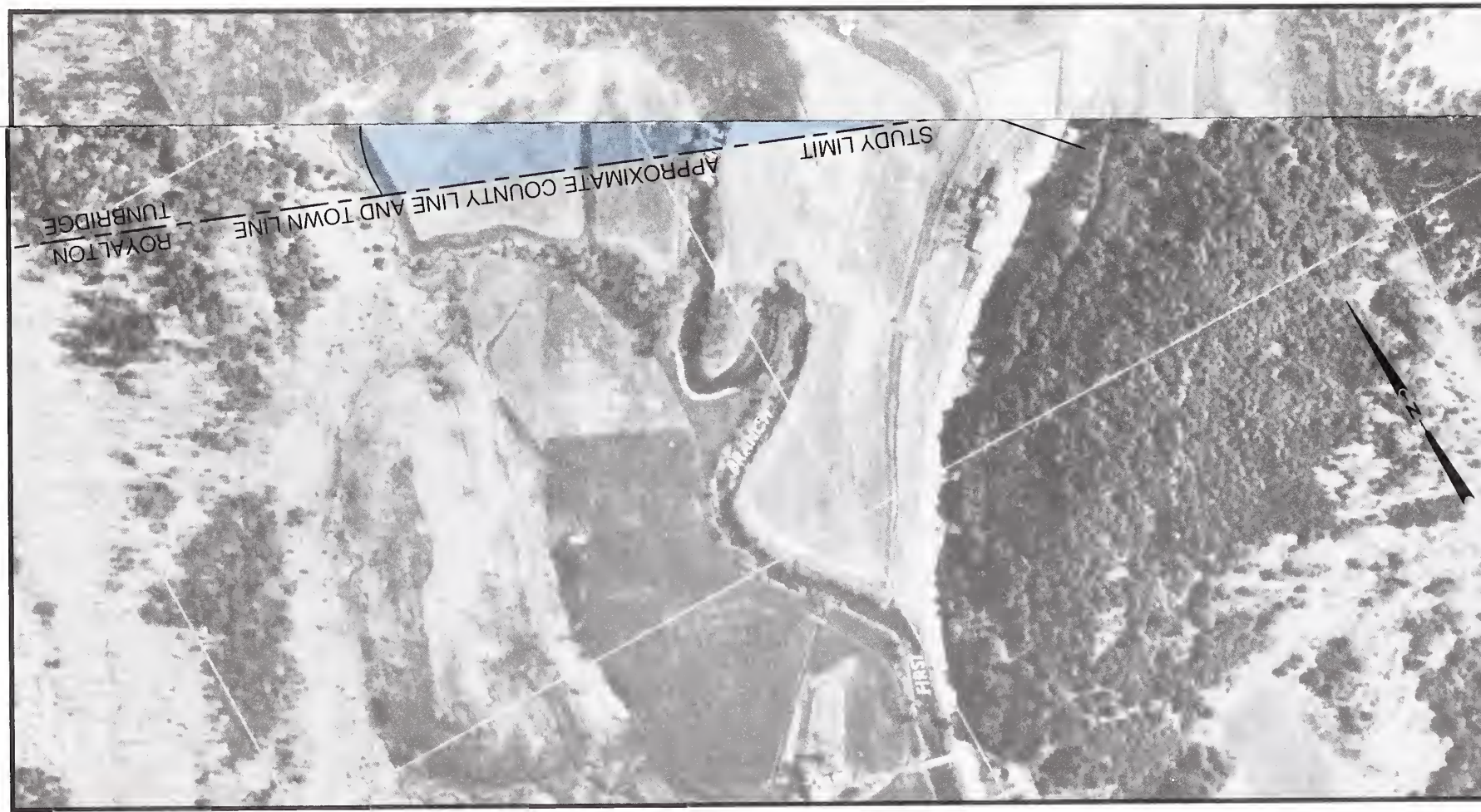
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

FIRST BRANCH WHITE RIVER

JANUARY 1005692-02

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE --TUNBRIDGE-- FLOOD PLAIN MANAGEMENT STUDY ORANGE COUNTY, VERMONT	FLOOD PROFILES FIRST BRANCH WHITE RIVER



LEGEND

100 YEAR FLOOD AREA

500 YEAR FLOOD AREA

FB59 — SURVEYED CROSS SECTION

STREAM CHANNEL

RM 1 — BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

0 500 1000 F

0 100 200 300 M

1979 Photography by Vernon Graphics, Inc.

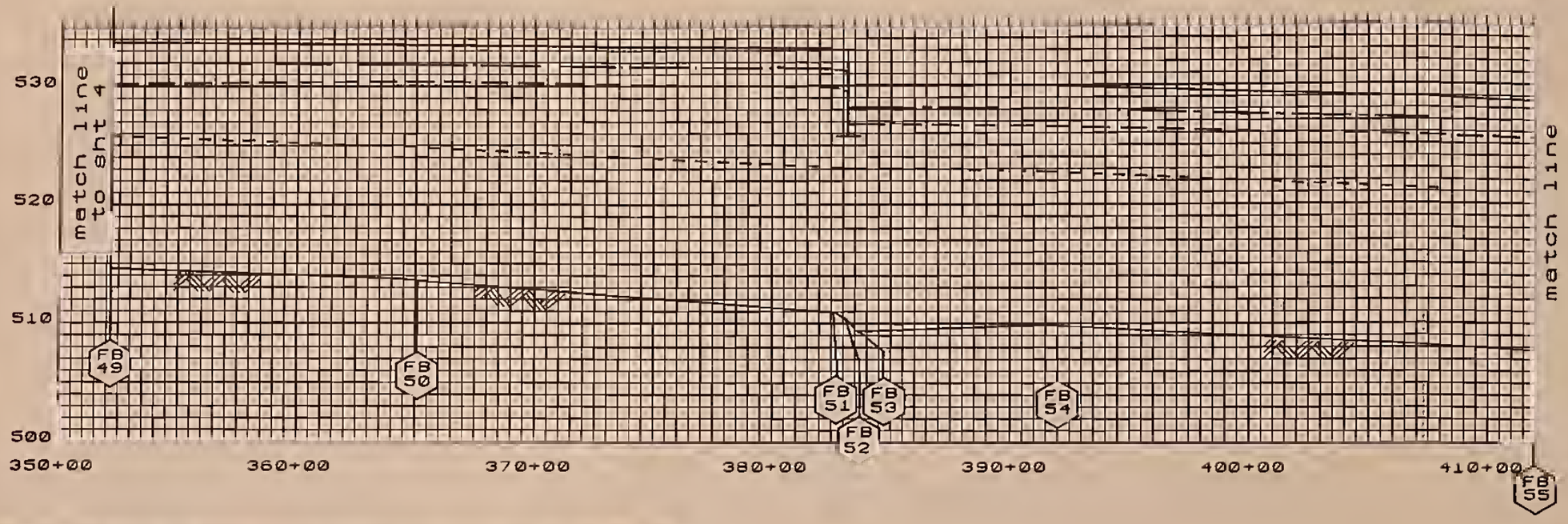
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY

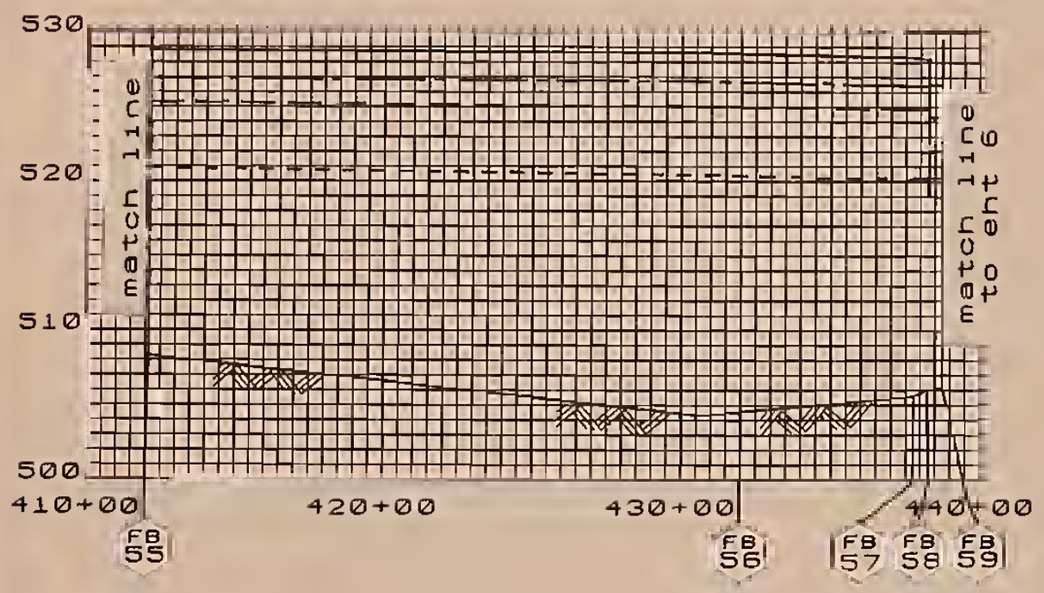
FLOOD HAZARD AREA

SHEET 6 O

JANUARY 19

USDA-SCS-NATIONAL CARTOG





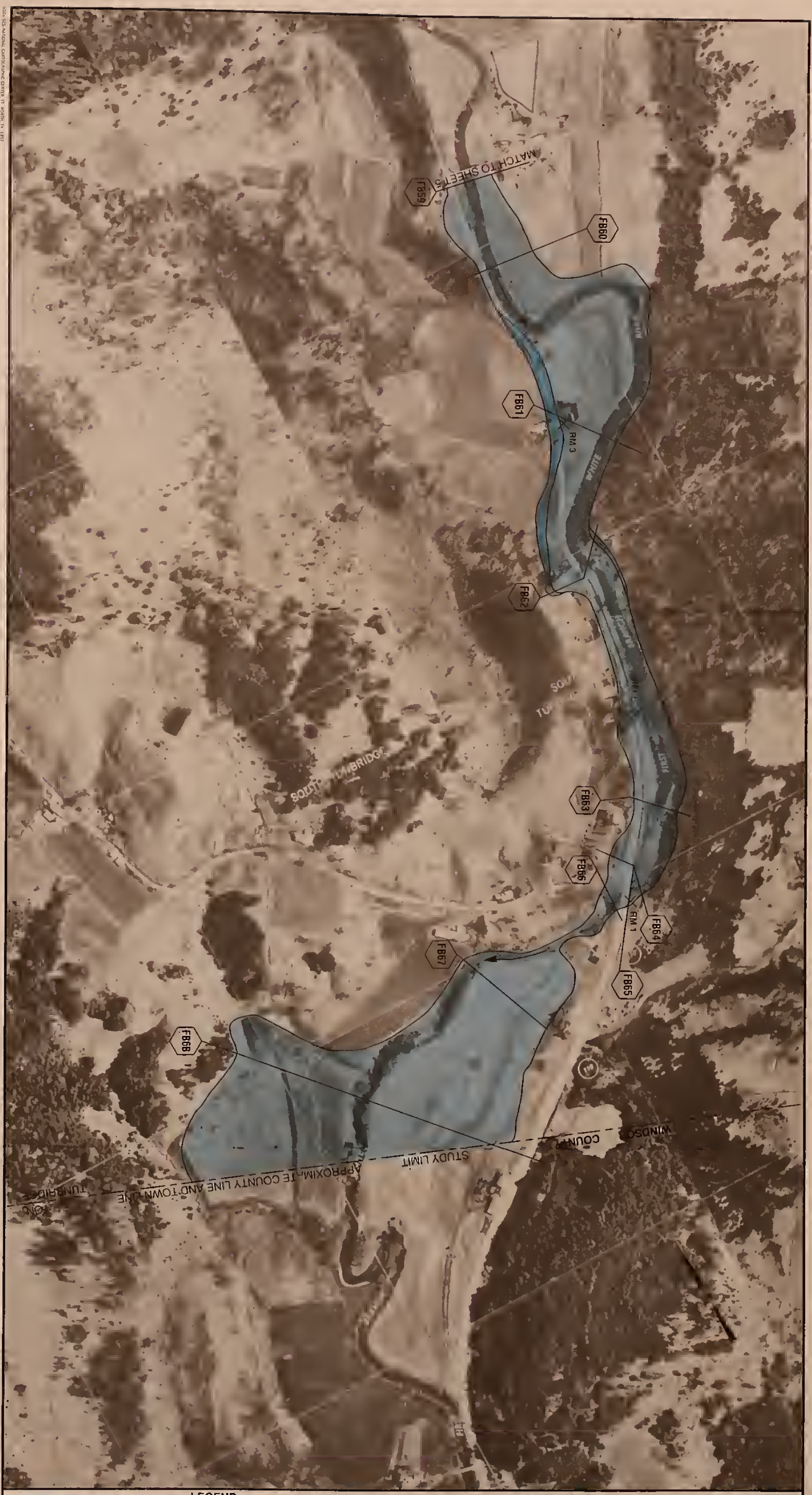
LEGEND

- 500 YEAR STORM
- 100 YEAR STORM
- 50 YEAR STORM
- 10 YEAR STORM
- STREAM BED
- 3 — CROSS SECTION LOCATION
- bridge deck / low chord — RIVER CROSSING

FLOOD PROFILES

FIRST BRANCH WHITE RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
--TUNBRIDGE--
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT



LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- FB59 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- RM 1 — BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

0 500 1000 FEET

0 100 200 300 METERS

1979 Photography by Vernon Graphics, Inc.

SHEET 6 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TUNBRIDGE
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

FIRST BRANCH WHITE RIVER

JANUARY 1055692-02

AR STORM

AR STORM

R STORM

R STORM

BED

SECTION
ON

CROSSING

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
--TUNBRIDGE--
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD PROFILES

FIRST BRANCH WHITE RIVER

Investigations and Analysis

Approximately 10 miles of differential levels to establish vertical control and 68 cross sections were surveyed for this study. Surveys are referenced to National Geodetic Vertical Datum (NGVD) of 1929. Reference mark Descriptions and Elevations are listed in preceding tables and located on appropriate photomaps.

Flood runoff volumes and flow rates were developed using the SCS computer model described in Technical Release No. 20 (Reference No.8). Flow-frequency values from this hydrologic model were adjusted as necessary in analyzing them along with values from other flood insurance studies. Flood plain geometry and hydraulic characteristics were acquired by field surveys along the river systems. Flood-frequency surfaces were computed using the adjusted flows from the hydrologic model as inputs to water surface profile development, using the Soil Conservation Service's Technical Release No. 61 (Reference No.9). The products of these analyses are the basis for much of the boundary elevation and profile information contained in this report. This report's information reflects coordination with evaluations made by others.

The flood stages provided for selected storm frequencies should be considered as minimum elevations for the prescribed uses of this report. Certain indeterminate factors and conditions affecting future flood flows could cause higher flood stages than indicated. These include ice and debris, clogging of bridges and culverts, sediment, ice and debris jams along the channel and flood plain, and changes in the vegetative character of the channels and flood plain.

Analysis of the hydraulic characteristics of streams were carried out using the SCS computer program WSP-2 (Ref. 9). Cross section data for the streams and structural geometry of bridges and culverts were obtained by transit surveys. From stage-discharge curves, elevations and flood boundaries were determined at the cross sections. Straight line interpolations of the elevations were used for flood profiles between cross sections. Flood boundaries between cross sections were drawn on the photomaps using USGS topographic maps and aerial photos as a guide. The results were reviewed with state and town officials to eliminate any obvious errors.

The photomaps were assembled as strips from 1:5000 scale, Vermont Mapping program, Orthophoto Maps by the USDA-SCS Fort Worth, Texas Cartographic Unit.

LEGEND

- 500 YEAR STORM
- 100 YEAR STORM
- 50 YEAR STORM
- 10 YEAR STORM
- STREAM BED
- 3 — CROSS SECTION LOCATION
- bridge deck / low chord — RIVER CROSSING

FLOOD PROFILES

FIRST BRANCH WHITE RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

--TUNBRIDGE--
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

Safety and Protection

This flood plain management study is an aid to persons living in flood prone areas. If your home is within the flood plain, the following information should serve as a guide for dealing with floods.

Being well informed is your best protection. It is extremely important to know where to go in the event of a flood. Remember that roads are often built in valleys where floodwaters will most likely go. You should reach higher ground, and it may be easier and safer to do this on foot, rather than by car.

The major causes of floods are melting snows and rainfall. Listen to the weather reports and be aware of the chance of flooding. Never ignore a flood warning. Listen for emergency instructions and follow instructions given.

If it is necessary for you to evacuate your home, do so quickly and cautiously. Follow evacuation instructions that are given. Do not try to take all of your belongings with you. Take necessary personal items such as eyeglasses, medicines, flashlights, a small supply of canned food, a can opener and several blankets.

If you are traveling by car you may encounter these hazards:

- washed-out roads or bridges
- undermined roadway
- landslides
- fallen rocks
- downed powerlines
- floating debris

Watch out for these hazards carefully.

If it is not necessary to evacuate your home, there are precautions you should proceed with.

Fill large containers with water and after doing so shut off the main water valve to protect the clean water already in your water system. Be certain to shut off your water heater since no water will be going to it.

As long as electric service is available it may be used safely unless the main circuits are flooded. In such a case you will reduce the risk of electrical shock and short circuits if you turn the power off. Do not touch the switch if you are wet or standing in water. Unless you detect a gas leak, you may continue to use gas systems.

Be aware that floods often produce fire hazards. Watch for broken or leaking gas or oil lines, flooded electrical circuits, flooded furnaces and other appliances, and inflammable or explosive materials which may come from upstream.

Anchor or move inside any belongings such as trash cans, toys, lawnmowers, etc. They may become hazards to people downstream if they are washed away.

Move livestock to high, open ground and if possible keep them from drinking flood water or eating feed soaked with flood water.

The following items could help improve your chances of survival if a flood occurs:

- portable radio and spare batteries
- first aid kit
- flashlights and spare batteries
- foods which require little or no cooking and no refrigeration
- blankets
- rope
- hand tools
- drinking water

Precautions taken to reduce losses from flooding are called floodproofing.

The basement walls of your home are probably not built to withstand the additional pressures of water-soaked soils. You will have less damage if you allow floodwaters to come in. When you receive a flood warning, remove articles from the basement and open a basement window. Fuse boxes and other equipment should not be located in the basement.

Floodproofing for homes with adequately reinforced basement walls could include: sealing cracks in walls and floors with hydraulic cement, installation of a sump pump with a reliable power source, placing heavy screens over windows to prevent breakage from floating objects, and placing valves on main drain lines to prevent backup of water.

It is important to remember that floodproofing can help reduce damages, it does not make it safe to remain in your home during a flood.

After a flood, reenter buildings with caution. Watch for fire hazards, displaced wild animals and falling debris. Do not use appliances until they have been checked for damage. Do not use any food or water which may be contaminated.

Normal home insurance does not cover flooding. Ask your insurance agent about federally subsidized flood insurance. Not all agents handle flood insurance and you may have to contact several of them.

Many people are hurt or killed during or after a flood by their own carelessness. Know before hand what to do if a flood occurs. Your local Civil Defense Agency can help you with any questions you may have.

FIRST BRANCH WHITE RIVER
Elevation (NGVD), Velocities (FPS), Discharge (CFS)

CROSS SECT.	CHANNEL ELEV.	10-YR STORM			50-YR STORM			100-YR STORM			500-YR STORM		
		ELEV. FT.	VEL. FPS	DSCHG CFS	ELEV. FT.	VEL. FPS	DSCHG CFS	ELEV. FT.	VEL. FPS	DSCHG CFS	ELEV. FT.	VEL. FPS	DSCHG CFS
FB1	671.0	678.0	12.1	5800	680.8	15.0	11000	682.1	16.0	14000	684.0	16.9	19000
FB2	670.5	677.2		5800	680.2		11000	681.6		14000	683.6		19000
	670.5	677.2		5800	680.0		11000	681.3		14000	683.0		19000
FB3	669.7	676.1	11.1	5800	678.8	14.0	11000	679.9	15.3	14000	681.4	16.9	19000
FB4	655.3	666.5	6.1	5800	669.4	7.2	11000	670.3	7.5	14000	671.6	7.9	19000
FB5	651.1	660.5	8.5	5800	663.2	8.9	11000	664.0	8.9	14000	665.3	8.8	19000
FB6	645.0	652.2	9.1	5800	654.9	10.6	11000	656.1	10.8	14000	657.6	11.2	19000
FB7	638.3	647.8	6.1	5800	651.2	7.3	11000	652.5	7.8	14000	654.1	8.6	19000
FB8	637.3	645.1	7.5	5800	648.6	9.2	11000	649.8	9.3	14000	651.5	9.4	19000
FB9	631.7	642.0	7.1	5800	645.1	8.7	11000	646.3	9.3	14000	647.8	10.3	19000
FB10	627.4	637.6	7.7	5800	640.5	8.4	11000	641.8	8.7	14000	643.2	8.6	19000
FB11	623.7	632.8	12.3	5800	635.9	13.2	11000	636.8	14.2	14000	637.9	15.6	19000
FB12	621.0	628.4	7.8	5800	631.2	10.5	11000	632.1	11.9	14000	633.2	13.9	19000
FB13	619.8	627.2	7.3	5800	630.2	8.6	11000	631.3	9.2	14000	632.7	10.0	19000
FB14	612.7	621.8	6.0	5800	625.6	5.6	11000	626.8	5.6	14000	628.3	5.8	19000
FB15	607.6	619.2	6.0	5800	624.0	6.1	11000	625.2	6.8	14000	626.6	7.6	19000
FB16	604.4	619.2		5800	624.0		11000	625.2		14000	626.6		19000
	604.4	617.9		5800	621.1		11000	622.4		14000	624.1		19000
FB17	607.4	616.8	9.5	5800	619.5	11.7	11000	620.6	12.6	14000	622.2	13.2	19000
FB18	601.4	611.3	6.2	5900	614.2	6.7	12000	615.5	7.0	15000	617.3	7.5	19000
FB19	598.7	607.8	5.8	5900	611.6	5.2	12000	613.2	5.3	15000	615.2	5.5	19000
FB20	590.8	603.6	8.0	6100	609.6	5.9	12000	611.4	6.1	15000	613.5	6.6	20000
FB21	587.2	599.9	6.7	6100	608.3	6.2	12000	610.1	6.6	15000	612.3	7.2	20000
FB22	588.0	599.6		6100	608.2		12000	610.0		15000	612.2		20000
	588.0	598.4		6100	601.7		12000	603.1		15000	604.7		20000
FB23	588.1	598.1	8.4	6100	601.4	10.8	12000	602.7	11.8	15000	604.2	13.2	20000
FB24	586.9	595.2	8.6	6100	598.1	10.6	12000	599.4	11.2	15000	600.7	12.4	20000
FB25	585.4	591.4	10.0	6100	593.6	13.6	12000	595.0	14.0	15000	596.8	13.5	20000
FB26	577.9	587.6	5.2	6100	590.0	6.9	12000	591.0	7.5	15000	592.2	8.4	20000
FB27	574.9	585.4	8.1	6100	587.7	7.7	12000	588.9	7.3	15000	590.1	6.9	20000
FB28	572.1	582.0	6.2	6100	584.7	6.3	12000	586.0	6.5	15000	587.6	6.9	20000
FB29	569.0	579.1	7.6	6100	581.7	10.1	12000	582.7	11.0	15000	584.1	12.2	20000
FB30	566.6	576.7	6.7	6100	579.0	7.5	12000	580.0	7.8	15000	581.3	8.3	20000

FIRST BRANCH WHITE RIVER
Elevation (NGVD), Velocities (FPS), Discharge (CFS)

CROSS SECT.	CHANNEL ELEV.	10-YR STORM ELEV. FT.	10-YR STORM VEL. FPS	10-YR STORM DSCHG CFS	50-YR STORM ELEV. FT.	50-YR STORM VEL. FPS	50-YR STORM DSCHG CFS	100-YR STORM ELEV. FT.	100-YR STORM VEL. FPS	100-YR STORM DSCHG CFS	500-YR STORM ELEV. FT.	500-YR STORM VEL. FPS	500-YR STORM DSCHG CFS
FB31	564.1	575.5	4.2	6100	578.0	4.1	12000	579.1	4.2	15000	580.7	4.3	20000
FB32	562.9	573.1	5.5	6100	575.9	6.8	12000	577.2	7.5	15000	578.7	8.2	20000
FB33	560.2	568.3	10.6	6100	570.0	13.1	12000	570.7	13.8	15000	571.8	14.9	20000
FB34	552.7	563.4	8.8	6100	566.8	11.7	12000	568.3	12.6	15000	570.6	13.1	20000
FB35	550.3	561.3	7.6	6100	564.2	11.1	12000	565.6	12.5	15000	568.4	12.6	20000
FB36	551.4	560.7		6100	562.8		12000	563.5		15000	564.8		20000
	551.4	560.7		6100	562.8		12000	563.4		15000	563.8		20000
FB37	549.8	560.7	6.4	6100	562.8	9.8	12000	563.4	11.4	15000	563.8	13.6	20000
FB38	554.1	559.1	11.2	6100	561.2	13.3	12000	562.0	14.2	15000	563.1	15.4	20000
FB39	540.5	548.0	10.8	6100	557.1	7.4	12000	559.5	7.4	15000	562.4	7.8	20000
FB40	536.9	548.0		6100	557.1		12000	559.5		15000	562.4		20000
	536.9	546.0		6100	549.3		12000	550.4		15000	552.0		20000
FB41	537.5	545.3	10.0	6100	547.9	12.8	12000	548.8	13.8	15000	550.0	15.2	20000
FB42	527.8	536.9	7.6	6100	539.1	9.2	12000	539.7	10.0	15000	540.7	10.7	20000
FB43	523.6	533.5	9.1	6100	535.8	8.4	12000	536.6	7.9	15000	537.7	7.4	20000
FB44	521.0	530.0	4.5	6100	533.8	4.1	12000	535.0	4.0	15000	536.4	4.0	20000
FB45	517.7	528.9	3.4	6100	532.8	2.7	12000	534.1	2.8	15000	535.8	3.0	20000
FB46	513.2	527.2	7.7	6100	531.8	6.5	12000	533.1	6.6	15000	534.8	6.8	20000
FB47	513.4	527.0		6100	531.7		12000	533.1		15000	534.7		20000
	513.4	526.9		6100	530.9		12000	532.3		15000	533.9		20000
FB48	515.2	526.3	7.5	6100	530.7	5.0	12000	532.1	5.1	15000	533.7	5.4	20000
FB49	514.6	525.8	3.7	6100	530.7	2.1	12000	532.0	2.2	15000	533.7	2.4	20000
FB50	513.7	524.9	2.5	6100	530.4	1.8	12000	531.8	2.0	15000	533.5	2.2	20000
FB51	510.9	523.1	7.8	6100	529.8	5.8	12000	531.4	4.8	15000	533.1	4.2	20000
FB52	510.3	522.9		6100	529.6		12000	531.2		15000	533.0		20000
	510.3	522.9		6100	526.6		12000	528.1		15000	530.0		20000
FB53	509.3	522.9	3.6	6100	526.6	3.9	12000	528.1	4.2	15000	530.0	4.6	20000
FB54	509.8	522.7	3.6	6100	526.5	3.5	12000	528.0	3.5	15000	529.9	3.8	20000
FB55	508.3	520.9	3.0	6300	525.3	2.4	12000	526.9	2.5	15000	528.8	2.8	20000
FB56	504.3	520.4	3.0	6300	525.0	3.0	12000	526.7	3.2	15000	528.6	3.6	20000
FB57	505.6	520.1	4.6	6300	524.8	4.5	12000	526.4	4.8	15000	528.3	5.4	20000
FB58	506.1	520.0		6300	524.8		12000	526.4		15000	528.3		20000
	506.1	519.0		6300	522.1		12000	524.3		15000	526.5		20000

FIRST BRANCH WHITE RIVER
Elevation (NGVD), Velocities (FPS), Discharge (CFS)

CROSS SECT.	CHANNEL ELEV.	10-YR STORM ELEV. FT.	10-YR STORM VEL. FPS	10-YR STORM DSCHG CFS	50-YR STORM ELEV. FT.	50-YR STORM VEL. FPS	50-YR STORM DSCHG CFS	100-YR STORM ELEV. FT.	100-YR STORM VEL. FPS	100-YR STORM DSCHG CFS	500-YR STORM ELEV. FT.	500-YR STORM VEL. FPS	500-YR STORM DSCHG CFS
FB59	506.1	518.9	6.3	6300	522.1	7.0	12000	524.3	6.6	15000	526.5	6.9	20000
FB60	505.8	519.0	3.6	6300	522.1	3.7	12000	524.3	3.4	15000	526.5	3.5	20000
FB61	504.9	518.0	6.3	6300	521.3	7.0	12000	523.8	6.2	16000	526.2	6.0	20000
FB62	505.5	517.0	8.8	6400	520.6	8.0	12000	523.5	6.2	16000	525.9	5.8	21000
FB63	502.8	511.4	10.8	6500	516.3	11.0	13000	521.5	7.4	16000	524.2	7.7	21000
FB64	497.5	509.8	8.5	6500	515.4	9.8	13000	520.9	8.0	16000	523.7	8.1	21000
FB65	496.8	509.7		6500	515.3		13000	520.9		16000	523.7		21000
	496.8	508.2		6500	511.9		13000	513.5		16000	516.6		21000
FB66	498.1	507.7	8.0	6500	511.2	10.5	13000	512.7	11.6	16000	515.8	11.9	21000
FB67	492.8	504.9	4.6	6500	508.9	4.2	13000	510.6	4.2	16000	514.7	3.4	21000
FB68	490.1	504.5	1.7	6500	508.8	1.3	13000	510.5	1.3	16000	514.7	1.2	21000

Town of Tunbridge Reference Marks

Number	Elevation	and Description
RM1	521.86	A standard AOT tablet set on the top of the curb at the southerly upstream end of the Route 110 bridge over the First Branch.
RM2	517.54	A nail in a power pole stamped 2-5/12 in South Tunbridge on the easterly side of Route 110.
RM3	519.27	A nail in a power pole stamped 6/93/84 located at the south westerly corner of a barn opposite a brick house on the westerly side of Route 110.
RM4	521.88	A chiseled square on top of the abutment of the Howe covered bridge over the First Branch. Chiseled square is located at the westerly downstream end of the bridge.
RM5	519.42	A nail in a power pole stamped 109 on the easterly side of Route 110 where the river comes against the highway.
RM6	530.16	A nail in a power pole stamped 107/116 on the easterly side of Route 110 approximately 150 feet northerly of intersection of Route 110 and a town road.
RM7	533.73	A 2 inch AOT tablet set on the top of the curb of the Route 110 bridge over the First Branch. Tablet located near the downstream southerly end of the bridge.
RM8	536.25	A nail in a power pole (no number) located on the easterly side of Route 110 in a field approximately 150 feet northerly of intersection of Route 110 with town road farm road (Howe Farm).
RM9	544.105	A U.S.G.S. tablet stamped M44 1928 set in the top of a ledge outcrop. Ledge outcrop located directly opposite a red brick house near cemetery.

Town of Tunbridge Reference Marks (Cont'd)

Number	Elevation	and Description
RM10	532.92	A nail in power pole stamped 4/65/5 located at the westerly upstream end of Cilley Bridge over the First Branch.
RM11	547.16	A chiseled square set on top of a concrete AOT project marker post stamped VT. 1958 S 1412 near small unnamed brook passing under Route 110.
RM12	536.34	A chisel square on a concrete slab which is flush with the ground at the entrance to the Grand Stand at the Tunbridge Fairground.
RM13	554.38	A chisel square on top of the abutment of the Mill covered bridge over the First Branch. Chisel square is located on the downstream easterly end of the bridge.
RM14	570.24	A chiseled square on the top of the upstream southerly abutment of the Route 110 bridge over the First Branch.
RM15	598.42	A nail in a power pole stamped 26/6/176 located on the easterly side of Route 110 on opposite side of highway of entrance to a driveway to two homes.
RM16	590.38	A nail in a power pole stamped 187/353/35 located in the westerly side of Route 110.
RM17	583.77	A chiseled square set on top of the southerly upstream end of the curb of a 4x8 concrete box culvert under Route 110, 50 feet northerly of the intersection of Route 110 and Monarch Hill Road.
RM18	580.38	A nail in a power pole stamped 201/48 near a driveway to a white wood-framed house on the westerly side of the highway. An old cemetery is on the opposite side of the river.

Town of Tunbridge Reference Marks (Cont'd)

Number	Elevation	and Description
RM19	581.99	A nail in a power pole stamped 6/211/58 located on the easterly side of Route 110.
RM20	589.24	A chiseled square set on top of northerly upstream end of the concrete rail of a concrete box culvert under Route 110. Culvert located at the intersection of Whitney Hill Road and Route 110.
RM21	598.20	A nail in a power pole stamped 225/72 on the easterly side of Route 110 near new woodframe house under construction.
RM22	603.24	A chiseled square on top of the upstream westerly abutment (laid stone) of the Foundry Road truss bridge over the First Branch.
RM23	616.30	A nail in a power pole stamped 24/353 with a transformer platform on the westerly side of Route 110 opposite a cribbed field drive.
RM24	624.08	A chiseled square on top of the downstream westerly abutment of Larkin Road covered bridge over the First Branch.
RM25	637.29	A chiseled square on top of the end wall at the remains of an old dam.
RM26	641.78	A standard AOT tablet located on the downstream northerly wingwall of a concrete box culvert under Route 110.
RM27	653.35	A nail in a power pole stamped 274/121 located on the easterly side of Route 110.
RM28	647.12	A nail in a power pole stamped 127/s on the westerly side of Route 110 opposite gravel pit on other side of river
RM29	688.49	A nail in a power pole stamped 288 located on the easterly side of Route 110 opposite L.B. Bowen's place.

Town of Tunbridge Reference Marks (Cont'd)

Number	Elevation	and Description
RM30	688.30	A nail in a power pole stamped 295/18 on the driveway to the Workspace Office Furniture plant (a large brown metal building).
RM31	693.41	A chiseled square on top of the downstream westerly abutment of Bicknell Hill Road covered bridge over the First Branch.
RM32	732.89	A nail in wooden marker post for a culvert on the westerly side of Route 110 at the Tunbridge/Chelsea Town Line